OSTEOSYNTHETIC AID

BACKGROUND OF THE INVENTION

[0001] The invention relates to an osteosynthetic aid for tubular bones. More specifically, the invention relates to a locking nail system as has become known for the fixation of fractures of tubular bones, particularly the femur, tibia or humerus. The basic principle is embodied in an elongate nail shank which has at least one cross-bore at each of its ends. The cross-bore is traversed by a bone screw or locking screw with which the nail shank is located in the bone in both the axial and rotational directions.

[0002] A peculiar problem in using locking nails of this type, e.g. for humeral head fractures, is posed by the postsurgical migration of the screws. Since the bone fragments may move or the bone is resorbed the bias which is produced while the locking nail is screwed in can be lost and, as a result, can cause the locking screw to come unscrewed.

[0003] When the locking nail is employed as a supracondylar nail it is known to pass a so-called tibial bolt through the condyles. It usually comprises a tibial bolt which has a relatively long shank and a threaded portion, and a tibial nut which is screwed onto the shank. The tibial nut can have a sleeve-shaped portion to allow a smooth shank to be formed between the nut and the head of the screw. If such a treatment is applied, also because bone elements are resorbed or fragments will shift, it might happen that it is no longer possible to sufficiently secure the location of the nail shank, i.e. it will migrate away sidewards, for example.

SUMMARY OF THE INVENTION

[0004] It is the object of the invention to provide an osteosynthetic aid which ensures that the tension originally

applied to a locking screw or tibial bolt essentially is maintained even after some time.

[0005] In the invention, a biasing sleeve which resiliently gives way or deformed in an axial direction, is disposed between the head of the locking screw and the nail shank.

[0006] According to an aspect of the invention, the biasing sleeve can have a radial flange at one end against which the head of the locking screw comes to bear.

[0007] When the invention is employed, the hole which is drilled in the bone after the cross-bore is found in the nail shank has to be provided with a diameter that also allows the introduction of the sleeve. The sleeve is dimensioned so that it comes to bear against the nail shank, thereby causing its flange to bear on the outer corticalis. Now, when the locking screw is turned in and is tightened the biasing sleeve is set to an axial bias or tension. Such bias provides for the tension to be maintained even when the distance changes between the corticalis and the nail shank because of changes within the bone. At this stage, the flange constitutes an abutment for the corticalis in applying the axial bias.

[0008] It is particularly advantageous to apply the invention to nail shanks the cross-bore of which has a thread which interengages with the thread of the locking screw. Such a construction not only helps predetermine an axial and rotational position, but also locate the lateral position of the nail.

[0009] According to the invention, when applied to a supracondylar nail, a provision is made to dispose a first biasing sleeve between the head of the tibial bolt and the nail shank and to dispose a second biasing sleeve between the nail shank and tibial nut. Such a configuration prevents the bolted joint of the tibial bolt from becoming loose, on one

hand, and the nail shank from moving sidewards (windshield wiper effect), on the other.

[0010] Various constructional approaches are imaginable to achieve an elastic action in an axial direction by means of a metallic sleeve. According to the invention, one approach provides that the biasing sleeve be given a series of axially spaced circumferential slots which are circumferentially offset. Preferably, the slots overlap each other circumferentially and preferably extend through an angle of more than 180°. According to another aspect of the invention, the offset between adjacent circumferential slots can be 90°, for example. It is also possible to use a coil spring for the biasing sleeve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The invention will be described in more detail below with reference to two embodiments.

[0012] FIG. 1 schematically shows a locking nail in a humerus to provide the humeral head with a biasing sleeve of the invention;

[0013] FIG. 2 schematically shows the distal femur with two biasing sleeves and a tibial bolt;

[0014] FIG. 3 shows a perspective view of a biasing sleeve of the invention; and

[0015] FIG. 4 shows a section through the biasing sleeve of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Referring to FIG. 1, there is shown the proximal portion of a humerus generally denoted as 10. The humeral head is denoted as 12. A locking nail 14 of a conventional structure is introduced through head 12. In the preferred embodiment, it is curved or bent at 16. In the preferred embodiment, the proximal portion has three cross-bores 18, 20 and 22 which are angularly offset and are located at an axial

distance from each other. Preferably, they are provided with a thread (not shown).

[0017] The cross-bores 18 to 22 serve for the reception of a locking screw one of which is shown at 24. Screw 24 has a head 26 and a shank 28 which has a threaded portion. The threaded portion is seated in the thread of cross-bore 20. Arranged on the shank 28 of locking screw 24 is a sleeve 30 which has a shank 32 positioned in an axial direction, and a radially circumferential flange 34 at one end.

[0018] During a surgery, the corticalis of the humerus 10 is bored open to such an extent that the biasing sleeve 30 can be passed through with the flange 34 coming to bear against the outer surface of the corticalis. Head 26 of locking screw 24 comes to bear on flange 34 while the locking screw is being threaded in. This is accomplished in a way that sleeve 30 is set to an axial bias, i.e. is slightly contracted in an axial direction. If the distance increases between the nail 14 and the corticalis the biasing sleeve 30 causes the locking screw to be maintained under sufficient tension and to be prevented from migrating away.

[0019] Referring to FIG. 2, a distal femur portion is outlined at 35. A locking nail 36 is driven in between the condyles from the underside, as is known and shown in U.S. Patent No. 6,010,505 and U.S. Publication No. 20020055743. As is typical, the nail has at least one lower cross-bore in the distal area and has at least one upper cross-bore (not shown) in the proximal area. The lower cross-bore is designated 38. It is traversed by the shank of a tibial bolt 40 which cannot be seen in detail and which has a head 42. Bolt 40 is similar to that shown in U.S. Patent No. 6,010,505. The end of the tibial bolt 40, which protrudes on the opposite side of the respective condyle, has screwed thereon a tibial nut 44. This locates the shank of the nail 36 in both the axial and rotational directions. In

the preferred embodiment, a biasing sleeve 46 and 48, respectively, is disposed between the nail shank 36 and the head 42 of the tibial bolt 40, on one hand, and between the shank and the tibial nut 44, on the other. In the preferred embodiment, its structure is the same as that of sleeve 30 of FIG. 1.

[0020] The assembly described helps in axially biasing the biasing sleeves 46, 48 which ensure that if the bolted joint becomes loose the nail shank does not shift and the bolt elements do not migrate.

[0021] FIGS. 3 and 4 illustrate a preferred embodiment of such a sleeve, e.g. sleeve 30. A smooth sleeve portion 50 is provided at the end opposed to flange 34. A series of axially spaced circumferential slots 52 are provided between the portion 50 and flange 34 which extend through more than 180° around the circumference of the sleeve and overlap each other by 90° each. Preferably, the width of the slots is somewhat less than the width of the web portions 54 between adjacent slots 52. This achieves a sufficient elastic action when the appropriate material is chosen and the thickness is sufficient.

[0022] As can be seen from FIG. 4, the annular flange 34 has a circumferential chamfer 56 at the edge opposed to the shank 32. At the free end, the smooth portion 50 is also provided with a chamfer 58 to facilitate introduction into the bone.

[0023] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit

and scope of the present invention as defined by the appended claims.